Effect of Pre-measurement Relaxation Time on Manual Blood Pressure Measurement

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Abstract

In clinical practice, blood pressures (BPs) are often measured without relaxation before the measurement is taken, allowing little time for BP to stabilise. However, there is little evidence on the effect of pre-measurement relaxation time on manual BP measurement. This study aimed to provide these data.

Twenty subjects were studied. Manual systolic and diastolic BPs (SBP and DBP) were obtained by a trained observer. There were two sessions for each subject with two pre-measurement relaxation times (none and 10 min). Within the first session, the subjects were asked to sit relaxed at the reception for a 10 min before entering the measurement room. Three sequential BP measurements were then taken at 0, 10, and 20 min. For the second session, the subjects were asked to walk around for 800 m at their normal walking speed before a similar series of BP measurements were taken. The measured BPs were then compared between the two pre-measurement relaxation times.

ANOVA analysis showed there was no significant sequential changes in BPs ($P>0.15$), and there was no effect of pre-measurement relaxation time on SBP. However, the effect of the two relaxation times (none and 10 min) on DBP was significant ($P<0.05$). On average, the DBP measured with no relaxation was 1.7 mmHg higher than with 10 min relaxation.

In conclusion, this study quantified the effect of relaxation period on manual BP measurement.

1. Introduction

Blood pressures (BPs) are one of the most important clinical and diagnostic parameters used by clinical doctors and healthcare providers, and are still one of the most inaccurately measured [1-3]. BP measurement accuracy is associated with the condition in which a BP measurement is taken.

To achieve accurate BP measurement, various international organizations, including the American Heart Association (AHA), European Society of Hypertension (ESH) and British Hypertension Society (BHS), recommend that subjects should be instructed to relax as much as possible before the measurement is taken [1-3].

However, there is no scientific evidence available on the optimal time that an individual should remain in a particular position before a measurement is taken. In clinical practice, BPs are often measured without relaxation, allowing little time for BP to stabilise.

The aim of this study was to quantify the effect of pre-measurement relaxation time on manual BP measurement.

2. Methods

2.1. Subjects

Twenty healthy normotensive subjects (aged from 24 to 61 years) were studied. They were 11 male and 9 female subjects. They had no known cardiovascular disease. The detailed subject demographic information including age, height, weight and arm circumference are summarized in Table 1. This study received ethical permission from the Newcastle & North Tyneside Research Ethics Committee, and all subjects gave their written informed consent to participate in the study.

Table 1. General data information for the subjects studied. Their means and standard deviations (SDs) are presented.

Subject information		
No. subjects	20	
No. male	11	
No. female	9	
	Mean	**SD**
Age (years)	42	12
Height (cm)	171	9
Weight (kg)	75	13
Arm circumference (cm)	29	3

2.2. Manual auscultatory blood pressure measurement

Manual systolic and diastolic BPs (SBP and DBP) were obtained by a trained observer using a clinically validated manual electronic sphygmomanometer (Accoson Greenlight 300 from AC Cossor & Son (Surgical) Ltd) [4]. All BP measurements were performed in a quiet and temperature controlled clinical measurement room while the subjects were seated on a chair.

For each subject, there were two sessions with two different pre-measurement relaxation times (none and 10 min). Figure 1 gives a schematic diagram illustrating the experimental procedure.

Within the first session, the subjects were asked to sit relaxed at the reception for 10 min before entering the measurement room. Three sequential BP measurements were then taken over a period of 20 min at different time points (0, 10, and 20 min).

For the second session, the subjects were asked to walk around for 800 m at their normal walking speed before they entered the measurement room. A similar series of BP measurements were taken at 0, 10, and 20 min. Therefore, there was no relaxation time provided for the second session.

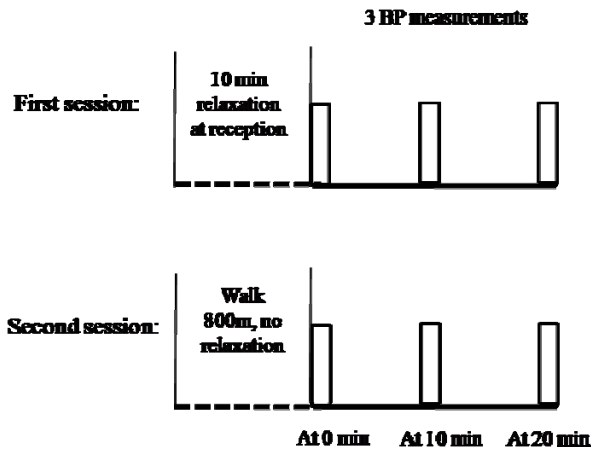

Figure 1. Schematic diagram of the experimental procedure.

2.3. Data and statistical analysis

The mean and standard deviation (SD) of the manual BPs across all subjects were calculated at the three measurement time points (0, 10 and 20 min), separately for with and without relaxation time.

The SPSS Statistics 19 software package (SPSS Inc, USA) was then employed to investigate the sequential change in BPs and the effect of pre-measurement relaxation time on BPs. The post-hoc multiple comparisons were then used to examine the statistical difference between the three sequential measurements and between the two pre-measurement relaxation times. A $P<0.05$ was considered statistically significant.

3. Results

3.1. Sequential blood pressure changes

ANOVA analysis showed that there was no significant sequential changes in both SBP and DBP (both $P>0.15$). As shown in Figure 2 and Table 2, the paired SBP changes (mean±SD) at 10 min and 20 min from 0 min were -1.1±5.6 and 0.6±6.8 mmHg (with 10 min relaxation), and -0.7±7.1 and -0.9±6.5 mmHg (without relaxation). Their corresponding changes for DBP were 1.3±5.2 and 1.9±7.8 mmHg (with 10 min relaxation), and 0.8±3.3 and 1.7±4.3 mmHg (without relaxation).

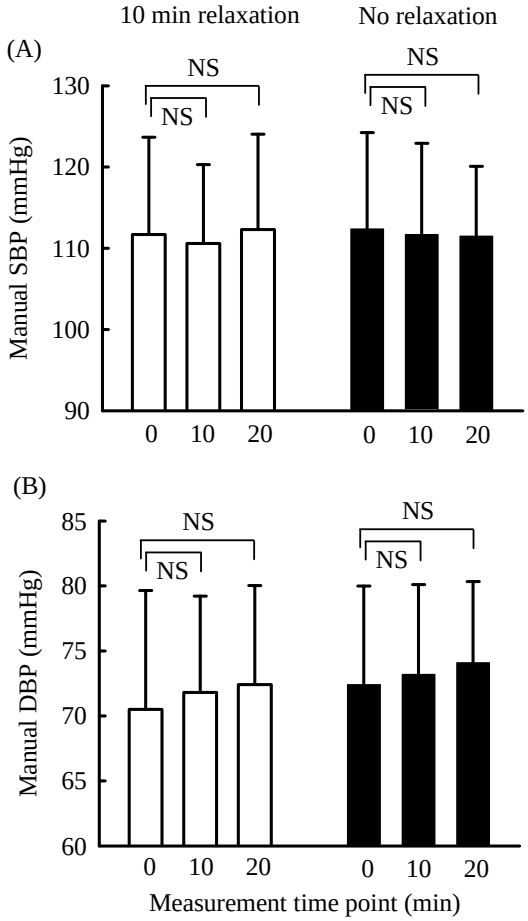

Figure 2. Overall mean±SD of manual SBP (A) and manual DBP (B) measured at different time points (0, 10 and 20 min). Their values for the two different pre-measurement relaxation times (none and 10 min) are given.

Table 2. Sequential changes (mean±SD) of manual SBP and DBP at 10 and 20 min when referenced to the measurements taken at 0 min.

	Pre-measurement relaxation time	BP difference to 0 min (mmHg)	
		at 10 min	at 20 min
SBP	10 min	-1.1±5.6	0.6±6.8
	None	-0.7±7.1	-0.9±6.5
DBP	10 min	1.3±5.2	1.9±7.8
	None	0.8±3.3	1.7±4.3

3.2. Effect of pre-measurement relaxation time on blood pressures

There was no effect of pre-measurement relaxation time on SBP. However, the effect of the two relaxation times (none and 10 min) on DBP was significant ($P<0.05$). On average, the DBP measured with no relaxation was 1.7 mmHg higher than with 10 min relaxation.

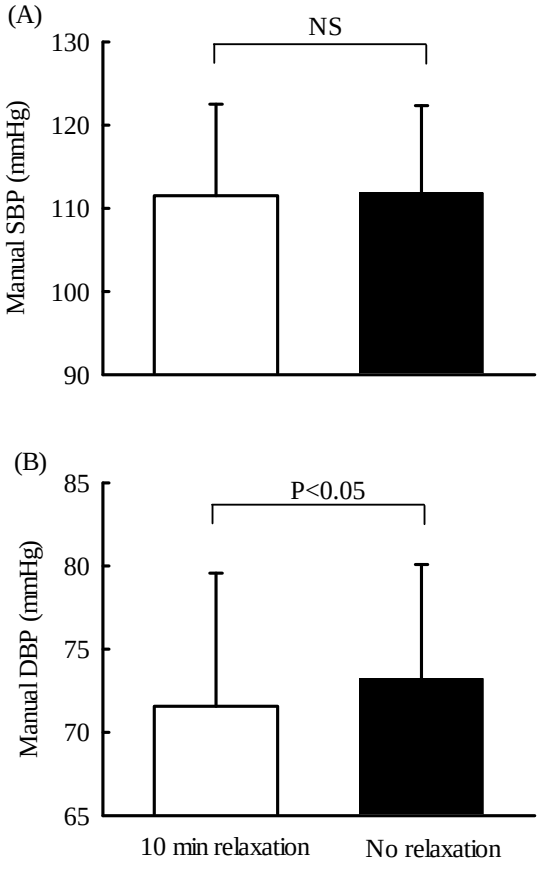

Figure 2. Comparison of manual SBP (A) and manual DBP (B) between the two pre-measurement relaxation times. The average BPs from the three sequential measurements were used for comparison.

4. Discussion and conclusion

In this study, significantly higher manual DBP was obtained when there was no relaxation before the measurements were taken, indicating that BPs should not be measured immediately after the patients arrive at the clinic.

Sequential BP measurements in any individual subject are important. This study also showed that there was no significant sequential change in manual BPs if the measurements were taken with the interval of 10 min. However, it has been reported that, from three sequential measurements with 1 min interval, the first reading could be significantly higher than the second and third readings [5-7]. Therefore, in order to fully understand the sequential BP changes, BP measurements need to be performed over a long period with short time intervals, and further investigation needs to be followed up to better understand the reasons causing the sequential BP changes.

It is highly recommended by various international hypertension organizations that, before BPs are measured, subjects should be given enough time to relax [1-3]. However, the optimal relaxation time is not known. Further investigation therefore needs to be followed up to identify how different pre-measurement activities affect the time needed for BP to stabilise

One limitation of this study is that only healthy subjects were included. Future studies should use a large number of clinical groups, including patients with hypertension, to investigate whether similar effect could be observed.

In summary, we have quantitatively shown that pre-measurement relaxation time had a significant influence on BP measurement. These quantitative findings provide scientific support for measurement protocols asking subjects to relax before the measurement.

Acknowledgements

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